DOCUMENT RESUME

ED 448 200 TM 032 230

AUTHOR Onwuegbuzie, Anthony J.

TITLE Science Process Skills and Achievement in Research Methodology Courses.

PUB DATE 2000-11-15

NOTE 9p.; Paper presented at the Annual Meeting of the Mid-South Educational Research Association (28th, Bowling Green, KY, November 17-19, 2000).

PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS *Academic Achievement; Competence; *Graduate Students; Graduate Study; Higher Education; Knowledge Level; Methods Courses; Performance Factors; *Research Methodology; *Science Process Skills

ABSTRACT

The purpose of this study was to investigate the relationship between students' competency in science process skills and their conceptual knowledge of research concepts, methodologies, and applications. Participants were 124 graduate students enrolled in several sections of a required introductory-level course in research methodology. Science process skills were measured via the Test of Integrated Process Skills II, and performance in the research methods class was assessed through midterm and final examinations. Findings reveal that students who demonstrated the highest competency in process skills also tended to exhibit the highest levels of performance in the research methods course at both the midterm and final examination stages. These relationships were moderate to large. (Contains 11 references.) (Author/SLD)

Reproductions supplied by EDRS are the best that can be made
from the original document.

TM

ED 448 200

Running head: SCIENCE PROCESS SKILLS

Science Process Skills and Achievement in Research Methodology Courses

Anthony J. Onwuegbuzie

Valdosta State University

A. J. Onwuegbuzie

1

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
✓ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

TM032230

Paper presented at the annual meeting of the Mid-South Educational Research Association, Lexington, Kentucky, November 15, 2000.

BEST COPY AVAILABLE

Abstract

The purpose of this study was to investigate the relationship between students' competency in science process skills and their conceptual knowledge of research concepts, methodologies, and applications. Participants comprised 124 graduate students enrolled in several sections of a required introductory-level course in research methodology. Science process skills was measured via the Test of Integrated Process Skills II, whereas performance in the research methods class was assessed via midterm and final examinations. Findings revealed that students who demonstrated the highest competency in process skills also tended to exhibit the highest levels of performance in the research methods course at both the midterm and final examination stages. These relationships were moderate to large.

Science Process Skills and Achievement in Research Methodology Courses

Graduate programs in the fields of social and behavioral sciences typically include required courses in research methodology. Unfortunately, a high proportion of students find these courses to be extremely difficult, experiencing lower levels of performance in these classes than in other courses in their programs of study (Onwuegbuzie, 1997, 1998). Yet, as noted by Onwuegbuzie, Slate, Paterson, Watson, and Schwartz (in press), little is known about the characteristics of students who experience the most difficulties in these classes. However, recent evidence suggests that certain learning styles and study habits are better predisposed to understanding research concepts (Onwuegbuzie, 1997; Onwuegbuzie & Daley, 1997; Onwuegbuzie et al., in press; Onwuegbuzie, Slate, & Schwartz, in press). These findings, together with the fact that research involves application of the scientific method (Gay & Airasian, 2000), suggest that students who demonstrate science process skills may be at an advantage in courses in research methods. However, to date, this link has not been investigated. Thus, the purpose of the present study was to investigate the relationship between graduate students' competency in science process skills and their conceptual knowledge of research concepts, methodologies, and applications.

According to Carin and Sund (1989), the necessary science process skills include classifying, generating models, formulating hypotheses, generalizing, identifying variables, inferring, interpreting data, making decisions, manipulating materials, measuring, observing, predicting, recording data, replicating, and using numbers to determine relationships, or to calculate or to apply mathematical formulae. These skills

are important in research methodology courses (Onwuegbuzie, 1997). Therefore, it was hypothesized that a relationship exists between science process skills and performance levels in research methods courses.

Methods

Participants

The sample consisted of 124 graduate students from a number of social and behavioral disciplines (e.g., early childhood education, secondary education, speech language pathology, and psychology) who had enrolled in six sections of an introductory-level educational research course at a university in the southeastern United States.

Instruments

On the first day of class, participants were administered the Test of Integrated Process Skills (TIPS II). TIPS II measures science process skills (i.e., identifying variables, operationally defining variables, identifying appropriate hypotheses, interpreting data, and designing instruments). This instrument contains 36 items, with scores ranging from 0 to 36. According to Downing, Filer, and Chamberlain (1997), TIPS II is a "frequently used instrument that yields satisfactory results" (p. 6). TIPS II has been used at both the secondary and post-secondary school level. With respect to the latter, Downing and Gifford (1996) found that preservice elementary teachers who obtained the highest scores on the TIPS II (i.e., indicated high levels of competency on science process skills) asked significantly more questions and demonstrated an increased use of divergent, high level questions in their teaching performance than did their lower-scoring counterparts. Additionally, Downing et al. (1997) reported a significant positive

relationship between teachers' scores on the TIPS II and their attitudes toward science and confidence in the ability to learn and to perform well in science. Strawitz (1989) reported a Cronbach's Alpha reliability estimate of .89. For the present study, a coefficient alpha of .71 was found.

Conceptual knowledge, which involved students' knowledge of research concepts, methodologies, and applications, was measured individually via comprehensive written midterm and final examinations. The examination form consisted of open-ended questions, involving items which required knowledge of the research process. All of the items pertained to content from the first half of the course and were chosen from the instructor's item bank to ensure that the examination was typical of past examinations given by this instructor. The final examination also was constructed by the course instructor and paralleled the format of the midterm examination, yet covered the complete course content. Both the midterm and the final examination were administered under untimed conditions, and were scored on a 100-point scale by the instructor, using a key that specified the number of points awarded for both correct and partial-credit answers.

Results and Discussion

Findings revealed a statistically significant relationship between scores on the TIPS II and scores on both the midterm ($r = .42$, $p < .01$) and final ($r = .36$, $p < .01$) examinations. These findings suggest that science processing skills predict 17.6% and 13.0% of the variance in achievement in research methods courses at the midterm and final stages, respectively. Using Cohen's (1988) criteria, these relationships are

moderate to large.

With respect to course grades in the research methods course, an independent *t*-test revealed that students who attained overall "A" grades in the class ($M = 27.3$, $SD = 3.9$) had statistically significantly higher scores on the TIPS II ($t = 2.50$, $p < .05$) than did students who attained a "B" grade or lower ($M = 23.2$, $SD = 3.8$). This difference represents a 1.1 standard deviation difference, representing a large effect size (Cohen, 1988). These results suggest that students with good science process skills may be at an advantage with respect to understanding the research process in general and performance levels in research methods courses in particular.

References

Carin, A.A., & Sund, R.B. (1989). *Teaching science through discovery* (6th ed.). Columbus, OH: Merill.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). New York: John Wiley.

Downing, J.E., & Gifford, V. (1996). An investigation of preservice teachers' science process skills and questioning strategies used during a demonstration science discovery lesson. *Journal of Elementary Science Education, 8,* 64-75.

Downing, J.E., Filer, J.D., & Chamberlain R.A. (1997, November). *Science process skills and attitudes of preservice teachers.* Paper presented at the annual meeting of the Mid-South Educational Research Association, Memphis, TN. (ERIC Document Reproduction Service No. ED 416 191)

Gay, L.R., & Airasian, P.W. (2000). *Educational research: Competencies for analysis and application* (6th ed.). Englewood Cliffs, N.J.: Prentice Hall.

Onwuegbuzie, A.J. (1997). Writing a research proposal: the role of library anxiety, statistics anxiety, and composition anxiety. *Library and Information Science Research, 19,* 5-33.

Onwuegbuzie, A.J. (1998). Teachers' attitudes towards educational research courses: Implications for the teacher-as-researcher movement. *GATEways to Teacher Education, 11,* 39-51.

Onwuegbuzie, A.J., & Daley, C.E. (1997). Learning style and achievement in a course on research methods. *Psychological Reports, 80,* 496-498.

Onwuegbuzie, A.J., Slate, J., Paterson, F., Watson, M., & Schwartz, R. (in press). Factors associated with underachievement in educational research courses. *Research in the Schools, 7*, 53-65.

Onwuegbuzie, A.J., & Slate, J., & Schwartz, R.A. (In press). The role of study skills in graduate-level educational research courses. *Journal of Educational Research*.

Strawitz, B.M. (1989). The effects of testing on science process skill achievement. *Journal of Research in Science Teaching, 26*, 659-664.